Fermilab

Particle Physics Division

Mechanical Department Engineering Note

Number: MD-Eng-147 Date: August 1, 2008

Project: DECAM

Project Internal Reference: LN2 Testing at Lab A

Title: ASME Calculations for the 200 Liter 18 inch Flange

Author(s): Herman Cease

Reviewer(s): Thomas Page 8/4/08
THOMAS PAGE TD/SRF

Key Words:

Abstract/Summary:

Applicable Codes:
ASME DIVISION I SECTION VIII,
ASME B16.5 Pipe Flanges and Flanged Fittings

PRESSURE VESSEL ENGINEERING NOTE

PER CHAPTER 5031

Prepared by: Herman Cease
Preparation date: Aug 14, 2008

1. Description and Identification
Fill in the label information below:

This vessel conforms to Fermilab ES&H Manual Chapter 5031

Vessel Title DES Pressure Vessel, 200L PHPK Technologies

Vessel Number 5819 PPD 10117

Vessel Drawing Number PHPK Technologies, 07-1963-0500 REV A

Maximum Allowable Working Pressures (MAWP):
Internal Pressure 150 PSIG
External Pressure -14.7 PSIG

Working Temperature Range -320°F to 120 °F

Contents Liquid Nitrogen

Designer/Manufacturer PHPK Technologies
Columbus Ohio

Test Pressure (if tested at Fermi) Acceptance Date:

PSIG, Hydraulic Pneumatic

Accepted as conforming to standard by

of Division/Section PPD Date: 8/15/08

NOTE: Any subsequent changes in contents, pressures, temperatures, valving, etc., which affect the safety of this vessel shall require another review.

Reviewed by: Roger Rucker 10 10654 Date: 8/14/08

Director's signature (or designee) if the vessel is for manned areas but doesn't conform to the requirements of the chapter.

Date:

Date:
ES&H Director Concurrence

Amendment No.:	Reviewed by:	Date:

Fermilab

Date: May 12, 2008

EXHIBIT B
Pressure Testing Permit*

Type of Test:[]Hydrostatic [X] Pneumatic

Test Pressure: 165 psig **Maximum Allowable Working Pressure:** 150 psig

Items to be Tested
DECAM 200L vessel, previously pressure tested by the manufacturer
DECAM 200L Top flange.

Location of Test: Fermilab MAB **Date and Time** 7/16/08 10 AM

Hazards Involved
Pneumatic stored energy

Safety Precautions Taken

In addition to the items listed below, a JHA has been compiled and a testing procedure.

The test will be performed in the gated area outdoors behind MAB. The gated area will be removed of all personnel. The supply manifold is located inside MAB with the roll up door acting as a barrier between the personnel and the vessel.

The Vessel has already been pressure tested by the manufacturing vendor, PHPK and has a documented pneumatic test pressure of 182 psig. The portion of the vessel being tested is the top flange. The top flange is naturally at a higher elevation than the testing personnel and is pointed vertically up away from all other objects.

Prior to testing, the qualified person and the section safety officer will inspect the vessel and check the test setup for safety precautions per ASME Sec. VIII, Div 1, UG-100.

Special Conditions or Requirements: N/A

HC

Qualified Person and Test Coordinator Herman Cease, PPD/Mech Dept
Date 7/16/08

Division/Section Safety Officer Wayne Schwab
Dept/Date 7/16/08
PPD/ESH

Results

No visible leaks, Leak checked with Snoop 7/17/08 Herman Cease

Witness Wayne Schwab
(Safety Officer or Designee)

Dept/Date PPD/ESH 7/16/08

* Must be signed by division/section safety officer prior to conducting test. It is the responsibility of the test coordinator to obtain signatures.

FESHM 5031.1 PIPING ENGINEERING NOTE FORM

Prepared by: Terry Tope and Herman Cease Preparation Date: 7.31.08

Piping System Title: DES Lab A LN2 Test Piping System

Lab Location: Lab A Lab Location code:

Purpose of system / System description: Pump liquid nitrogen thru a cooling loop.

Piping System ID Number:

Appropriate governing piping code: B31.3

Fluid Service Category (if B31.3): Category-D / (Normal) / Category-M / High Pressure (circle one)

Fluid Contents: liquid nitrogen

Design Pressure: 150 psig max Design Temperature: 77 K

Piping Materials: 304/304L & 316/316L stainless steels

Drawing Numbers (PID's, weldments, etc.): 4900.000-ME-436389

Designer/Manufacturer: Herman Cease/PPD/MD

Test Pressure: 165 psig Test Fluid: nitrogen gas Test Date:

Statements of Compliance

Piping system conforms to FESHM 5031.1, installation ***is not*** exceptional: (Yes) / No

Piping system conforms to FESHM 5031.1, installation ***is*** exceptional and has been designed, fabricated, inspected, and tested using sound engineering principles: Yes / No

Reviewer's Signature: William M Morgan Date: 8/13/08

D/S Head's Signature: [signature] Date: 8/15/08

ES&H Director's Signature: _____ Date: _____
(if exceptional)

Director's Signature or Designee: _____ Date: _____
(if exceptional)

Fermilab

DES Lab A LN2 Test
Piping System Engineering Note

Rev	Date	Description	Originated by	Approved by
None	Aug 11, 2008	Original issue	T. Tope H. Cease	

Reviewed by: William M Lowry

Date: 8/13/08

HAZARDS

Step/Phase of Job	Safety Hazard	Precautions/Safety Procedures
1) Filling the Piping system with nitrogen gas during the pressure test.	Stored Energy. Rapid release of stored energy can cause damage to equipment and personnel.	The piping will be filled slowly (10% increments) and will be checked for leaks at each increment. If a leak is found, the pressure is immediately reduced by 50% per FESHM 5034
2) Filling the Piping system with nitrogen gas during the pressure test.	Stored Energy. Rapid release of stored energy can cause damage to equipment and personnel.	All personnel will be removed from the area of the test. The supply manifold is located in a vestibule shielded by the rest of the piping system.

Accepted: _____ Date: 8-13-08

Supervisor/Task Manager

My supervisor has reviewed this hazard analysis with me and I understand the hazards and required precautionary actions. I will follow the requirements of this hazard analysis or notify my supervisor if I am unable to do so.

Name (please print)	Signature	Date
Jim Tweed	James E Tweed	8/13/08
Herman Cease	Herman Cease	8/13/08
Stephen Jakubowski	Stephen J. Jakubowski	8/13/08

2060TA-1
Rev. 07/2004

HAZARD ANALYSIS

Work Plan Title: Installation of 5" Flex Line support bracket /DeCam LN2 Pump Test
Date: August 5, 2008
Prepared By: Ken Schultz
Reviewed By:(optional) 6215
Approved By: 10173N
Supervisor/Task Manager

Description of work: An aluminum bracket of 5" rolled channel to be installed at an approximate height of 40', attached to structural columns using heavy-duty c-clamps. Two personnel will hoist the bracket using a cherry picker type man lift, with the bracket secured to the basket till bracket is in place and securely clamped to designated columns. Approximate weight of bracket is 65 lbs.
Two personnel will be in the basket and install bracket. One ground person to maintain safety exclusion area for protection from falling objects.

Personal Protective Equipment: (Check protective equipment required for the job.)

□ **Safety glasses** □ Side shields	□ Chemical splash goggles
□ Hearing Protection	□ Hard Hats
□ 3.0 Braising goggles	□ Impact goggles
□ Face shield	□ Rubber apron
□ Leather gloves	□ Hot/Cold thermal protective gloves
□ Chemical resistant gloves (specify type):	□ Respirators
□ Other required PPE (specify):	□ Fall protection equipment (specify):

Equipment required for the job: (List the tools needed to perform the job.)
Man lift, one adjustable wrench, one heavy duty bull dog clamp, three heavy duty c-clamps

Work Plan History Information: (List any lessons learned accidents from this job, tips from previous jobs)

HAZARD ANALYSIS

Step	Description	Hazards	Precautions / Safety Procedures
1	Lifting objects above 4'	Risk to personnel on floor	Secure area around lift point and have ground person exclude non-essential personnel from area.
2	Working at above 4'	Personnel performing task to understand task	Work process/steps to be discussed by personnel performing work before work to begin
3	Falling objects	Risk to personnel on ground	Exclude personnel from area around lift.
4	Review FESH Chapter on using man lifts before starting job	Machinery use	Review doc.
5	DISCONNECT & LOCK-OUT CRANE	BRIDGE MOVEMENT COLLIDING W/ HOIST	LOCK-OUT PER LOTTO-II
6			
7			
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(Use additional pages as needed.)

My supervisor has reviewed this hazard analysis with me and I understand the hazards and required precautionary actions. I will follow the requirements of this hazard analysis or notify my supervisor if I am unable to do so. I understand that there are Environmental, Safety and Health Professionals on staff if I need further assistance or clarification.

Name (please print)	Signature	Date
KEN SCHULTZ		8/5/08
TIM GRIFFIN		8/5/08

DECAM 200L Pressure Vessel
PRESSURE VESSEL TESTING PROCEDURE
6/16/08, H. Cease

Pressure testing the 200L Vessel for use in the Lab A Test are to follow the following procedures and guidelines. The pressure test will be a pneumatic test.

Overview of the testing procedure:

Test Setup:
The pressure test is performed using nitrogen gas obtained from nitrogen gas bottles. Approximately 1 bottle is required to fill the test vessel and achieve the full test pressure.

The supply manifold has all necessary operating valves and safety relief valves per 5034 Exhibit A. The manifold has a safety relief valve with a cracking pressure equal to 110% the MAWP of the vessel which is 150 psig * 1.10 = 165 psig. The relief valve cracking pressure is checked prior to the pressure vessel test. Relief valve is Anderson Greenwood 83MS66-3 with a capacity of 38scfm air.

Relief valve cracking pressure 165 psig

Safety Precautions:
The test will be performed in the gated area outdoors behind MAB. The gated area will be removed of all personnel. The supply manifold is located inside MAB with the roll up door acting as a barrier between the personnel and the vessel.

The Vessel has already been pressure tested by the manufacturing vendor, PHPK and has a documented pneumatic test pressure of 182 psig. The portion of the vessel being tested is the top flange. The top flange is naturally at a higher elevation than the testing personnel and is pointed vertically up away from all other objects.

Prior to testing, the qualified person and the section safety officer will inspect the vessel and check the test setup for safety precautions per ASME Sec. VIII, Div 1, UG-100.

> On welded pressure vessels to be pneumatically tested in accordance with UG-100, the full length of the following welds shall be examined for the purpose of detecting cracks:
> *(a)* all welds around openings;
> *(b)* all attachment welds, including welds attaching nonpressure parts to pressure parts, having a throat thickness greater than 1/4 in. (6 mm).

Initial Inspection Complete,
7/16/08 Date 7/16/08 Inspector 1 Herman Cease Inspector 2 Wayne Schmitt

Starting the Pressure Test

ASME Sec VIII Div 1 UG-100

The pressure in the vessel shall be gradually increased to not more than one-half of the test pressure. Thereafter, the test pressure shall be increased in steps of approximately one-tenth of the test pressure until the required test pressure has been reached. Then the pressure shall be reduced to a value equal to the test pressure divided by 1.1 and held for a sufficient time to permit inspection of the vessel. Inspection at the test pressure will be performed visually and using soap bubbles.

Pressure Steps

Step	Hold time	Comments
82 psig	5 minutes	10:19 am 12:50
98.5 psig	5 minutes	10:29 am 1:05
115 psig	5 minutes	10:34 Am 110 psi 1:12
131.5 psig	5 minutes	1:28
150 psig	5 minutes	1:34
165psig	5 minutes	1:45
150 psig	As needed for inspection min hold 30 minutes	151psig 1:50 No pressure drop 2:20

If a leak is detected at any pressure level reading during the test, the pressure shall be immediately reduced to one-half that pressure level reading while locating the leak.

If a leak is detected, the vessel and lines shall be depressurized before attempting any repairs or adjustments.

After inspection, the vessel shall be relieved of its pressure gradually through a valve at the test stand.

Final Inspection Complete,
7/17/08 Date Herman Cox Inspector 1 Wayne Schmidt Inspector 2

HAZARD ANALYSIS
DECAM 200L PRESSURE VESSEL
PRESSURE TEST

May 12,2008
Herman Cease

Description of Work:

A pneumatic pressure test of the DECAM 200L pressure vessel will be performed using FESHM 5034. During the pneumatic test, the pressure vessel will have substantial stored energy. Safety precautions are to be taken to mitigate risks associated with the pressure test.

Safety Precautions:

The test will be performed in the gated area outdoors behind MAB. The gated area will be removed of all personnel. The supply manifold is located inside MAB with the roll up door acting as a barrier between the personnel and the vessel.

The Vessel has already been pressure tested by the manufacturing vendor, PHPK and has a documented pneumatic test pressure of 182 psig. The portion of the vessel being tested is the top flange. The top flange is naturally at a higher elevation than the testing personnel and is pointed vertically up away from all other objects.

Prior to testing, the qualified person and the section safety officer will inspect the vessel and check the test setup for safety precautions per ASME Sec. VIII, Div 1, UG-100.

> On welded pressure vessels to be pneumatically tested in accordance with UG-100, the full length of the following welds shall be examined for the purpose of detecting cracks:
> *(a)* all welds around openings;
> *(b)* all attachment welds, including welds attaching nonpressure parts to pressure parts, having a throat thickness greater than 1/4 in. (6 mm).

HAZARDS

Step/Phase of Job	Safety Hazard	Precautions/Safety Procedures
1) Filling the DECAM 200L pressure vessel with nitrogen gas during the pressure test.	Stored Energy. Rapid release of stored energy can cause damage to equipment and personnel.	The vessel will be filled slowly (10% increments) and will be checked for leaks at each increment. If a leak is found, the pressure is immediately reduced by 50% per FESHM 5034
2) Filling the DECAM 200L pressure vessel with nitrogen gas during the pressure test.	Stored Energy. Rapid release of stored energy can cause damage to equipment and personnel.	All personnel will be removed from the area of the test. The vessel is located behind MAB in a gated area. The filling manifold and personnel will be separated from the vessel using the roll up door as a barrier.
3) Filling the DECAM 200L pressure vessel with nitrogen gas during the pressure test.	Stored Energy. Rapid release of stored energy can cause damage to equipment and personnel.	The vessel was pressure tested from the manufacturer. This is a pressure test of the end flange mounted to the pressure vessel. The flange is at a height above personnel and is mounted vertically. The flange points vertically away from all other objects.

Accepted: _____ Date: 7-16-08

Supervisor/Task Manager

My supervisor has reviewed this hazard analysis with me and I understand the hazards and required precautionary actions. I will follow the requirements of this hazard analysis or notify my supervisor if I am unable to do so.

Name (please print)	Signature	Date
HERMAN CEASE	Herman Cease	7/16/08
OTTO ALVAREZ	[redacted]	7/16/08
Wayne Schmitt	Wayne Schmitt	7/16/08

2060TA-1
Rev. 07/2004

HAZARD ANALYSIS

Work Plan Title: Installation of 5" Triple Walled Flex Line for the LN2 Pump Test in Lab A/Sidet
Date: August 5, 2008
Prepared By: Ken Schultz
Reviewed By:(optional) J. Q. Klinch 6215
Approved By: Ken Crouse #0173N
Supervisor/Task Manager

Description of work: This task involves the installation of the 5" flex hose, up the northeast column to the horseshoe. Around the horseshoe and down the crane support column. The hose will be secured by a combination of hose clamps and temporary cable ties. A ½" nylon line will be brought up the horseshoe and back down the northeast support column. The tag end of this rope will be attached to the lead end of the hose. This rope is primarily used to guide the hose along its path to the horseshoe and around it.
The hose will be lifted by a series of slings and rigging, choked around the hose and the free end tied off to the platform. The lift will be used to lift to the limit of the first rigging. At this point a second sling will be rigged to secure the hose and allow adjust the first rigging to allow furthers lifts. Repeat this process as necessary.
The free end of the ½" nylon line will be secured at each limit to act a secondary safety rigging. Two personnel will manage the free end of the ½" nylon rope and maintain a taught line during the lift.
The hose weighs 7lbs. per ft
The limit of the lift is 500lbs
One Person = 175 lb
Max hose length allowed to be lifted is 325lbs/7lbs = 53' of hose.

The most the lift will see is 40' of hose @ 7lbs = 280lbs. Well below the max weight limit of the lift.
Lift to be directed and conducted by Ken Schultz

Personal Protective Equipment: (Check protective equipment required for the job.)

□ **Safety glasses**	□ Chemical splash goggles
□ Side shields	□ **Hard Hats**
□ Hearing Protection	□ Impact goggles
□ 3.0 Braising goggles	□ Rubber apron
□ Face shield	

□ **Leather gloves**
□ Chemical resistant gloves (specify type):
□ Other required PPE (specify):

□ Hot/Cold thermal protective gloves
□ Respirators
□ **Fall protection equipment (specify):**

Equipment required for the job: (List the tools needed to perform the job.)
Continues slings, ½" three strand nylon rope, Large wire ties, hose clamps and ½" shackles.

Work Plan History Information: (List any lessons learned accidents from this job, tips from previous jobs)

HAZARD ANALYSIS

Step	Description	Hazards	Precautions / Safety Procedures
1	Overhead Crane	Danger of collision with lift and personnel	Lock out ---LOTTO II
2	Large Diameter Flex Line	Difficult to control/handle	Gloves and guide rope used to control.
3	Working at a height greater than 4'	Fall	Approved safety harness to be used and tied off to an approved tie off point.
4	Overhead work being performed.	Head injuries from falling tools, metal, etc.	Approved Hard Hats to be worn by ground personnel.
5	Works involves the use of man lift.	Collisions, pinches, crushing accidents	Read and understand the use and operation of lift. Review FESHM and have an appropriate training.
6	Rigging	Pinched or crushing	Only experienced personnel to perform rigging operations.

		accidents	
7	Personnel safety	Any of the above work could endanger untrained personnel	Exclude and control access to area of work. Safety personnel will be stationed to control access to area of work.
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(Use additional pages as needed.) My supervisor has reviewed this hazard analysis with me and I understand the hazards and required precautionary actions. I will follow the requirements of this hazard analysis or notify my supervisor if I am unable to do so. I understand that there are Environmental, Safety and Health Professionals on staff if I need further assistance or clarification.

Name (please print)	Signature	Date
Tim Griffin	Tim Griffin	8-6-08
Herman Cease	Herman Cease	8-6-08
Ken Schultz	Kenneth Schultz	8/6/08
Bill Moorhouse	Bill Moorhouse	8/6/08

DECAM LN2 Test Lab A
PRESSURE TESTING PIPING SYSTEM
8/11/08, H. Cease

Pressure testing the piping system used on the 200L Vessel Lab A Test are to follow the following procedures and guidelines. The pressure test will be a pneumatic test.

Overview of the testing procedure:

Test Setup:
The pressure test is performed using nitrogen gas obtained from nitrogen gas bottles. Approximately 1 bottle is required to fill the test vessel and achieve the full test pressure.

The supply manifold has all necessary operating valves and safety relief valves per 5034 Exhibit A. The manifold has a safety relief valve with a cracking pressure equal to 110% the MAWP of the piping system which is 150 psig * 1.10 = 165 psig. The relief valve cracking pressure is checked prior to the pressure piping system test. Relief valve is Anderson Greenwood 83MS66-3 with a capacity of 38scfm air.

Relief valve cracking pressure 165 psig

Safety Precautions:
The test will at Lab A. The outdoor area and the area under the dome in Lab A will be removed of all personnel. The supply manifold is located outdoors around the corner from the 200L Vessel, shielded from the piping system.

Prior to testing, the qualified person and the section safety officer will inspect the vessel and check the test setup for safety precautions per ASME B31 piping code.

> On welded pressure piping systems to be pneumatically tested in accordance with ASME B31 piping code, the full length of the following welds shall be examined for the purpose of detecting cracks:
> *(a)* all welds around openings;
> *(b)* all attachment welds, including welds attaching nonpressure parts to pressure parts, having a throat thickness greater than 1/4 in. (6 mm).

Initial Inspection Complete,
8-13-08 Date HC Inspector 1 _____ Inspector 2

Starting the Pressure Test

The pressure in the piping system be gradually increased to not more than one-half of the test pressure. Thereafter, the test pressure shall be increased in steps of approximately one-tenth of the test pressure until the required test pressure has been reached. Then the pressure shall be reduced to a value equal to the test pressure divided by 1.1 and held for a sufficient time to permit inspection of the vessel. Inspection at the test pressure will be performed visually and using soap bubbles.

Pressure Steps

Step	Hold time	Comments
82 psig	5 minutes	✓
98.5 psig	5 minutes	✓
115 psig	5 minutes	✓
131.5 psig	5 minutes	✓
150 psig	5 minutes	✓
165psig	5 minutes	✓
150 psig	As needed for inspection min hold 30 minutes	8/13/08 14:25 pressure no drop ✓

If a leak is detected at any pressure level reading during the test, the pressure shall be immediately reduced to one-half that pressure level reading while locating the leak.

If a leak is detected, the vessel and lines shall be depressurized before attempting any repairs or adjustments.

After inspection, the vessel shall be relieved of its pressure gradually through a valve at the test stand.

Final Inspection Complete,

8/13/08 Date HC Inspector 1 _____ Inspector 2